Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIFTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION - NOV/DEC 2016

SUBJECT: LINEAR DIGITAL CONTROL SYSTEM (ECE - 3101)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.
- Graph sheets will be provided.

1A. Obtain the closed loop transfer function C(s)/R(s) of the system shown in Figure Q1A using Mason's gain formula.

1B. For the mechanical system shown in Figure Q1B, obtain the transfer function $Y_1(s)$/ F(s).

1C. Find C(s)/R(s) of the block diagram shown in Figure Q1C using block diagram reduction technique.

(5+3+2)

2A. For the second order system described by the transfer function, determine the frequencies of undamped and damped oscillations, maximum overshoot peak time, rise time, settling time and the final value due to a unit step input.

$$\frac{C(s)}{R(s)} = \frac{144}{s^2 + 9.6s + 144}$$

2B. With reference to (-1+j0) point in G(jω)H(jω) plane, explain gain and phase margin, gain and phase crossover frequency with suitable sketches.

2C. A block diagram representation for a feedback control system is shown in Figure Q2C. The type of the system is
(i) Type 0 (ii) Type 1 (iii) Type 2 (iv) Type 3

(5+3+2)

3A. The open-loop transfer function of a unity feedback system has simple poles at s = -1, s = -3 and s = -5 and no finite open-loop zeros. Draw the root locus and find the condition for stability.

3B. A unity feedback system shown in Figure Q3B, is to be controlled by a proportional controller. Find the range of values of the gain K_p of the proportional controller for which the system remains stable.

3C. Determine the transfer function of the network shown in Figure Q3C.

(5+3+2)

4A. Derive the expression for the transfer function of a Type 1 pole-zero cancellation compensator.

4B. Using Bi-linear transformation find the stability for the characteristic equation $z^3 - 0.5z^2 + 2.49z - 0.496 = 0$

4C. Obtain C(z)/R(z) for a closed loop unity feedback system with error sampling.

(5+3+2)

5A. Check for controllability and observability of a system having following state equations.

$$\dot{x} = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 3 \\ -7 & 5 & 9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u(t) \quad and \quad y = \begin{bmatrix} 5 & 2 & 7 \end{bmatrix} x$$

5B. A discrete negative unity feedback system has $G(s) = \dfrac{0.2}{s+0.2}$ in series with ZOH. If T = 0.1 sec., using Kalman's algorithm, determine the controller transfer function D(z).

5C. Obtain the state transition matrix for the state model whose A matrix is given by $\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$

(5+3+2)

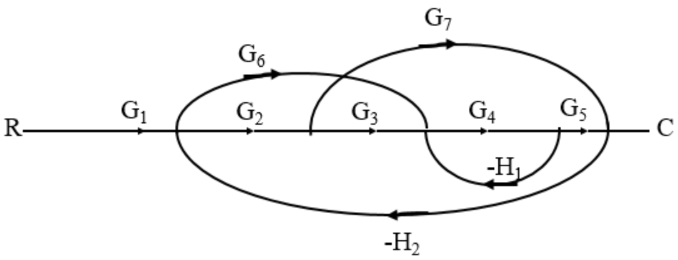


FIG Q1A

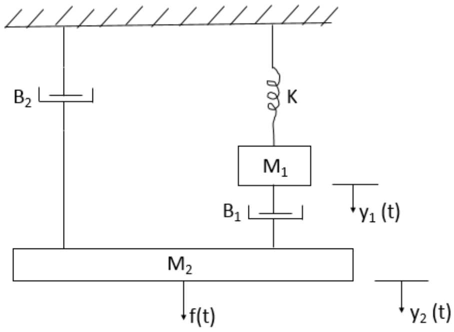


FIG Q1B

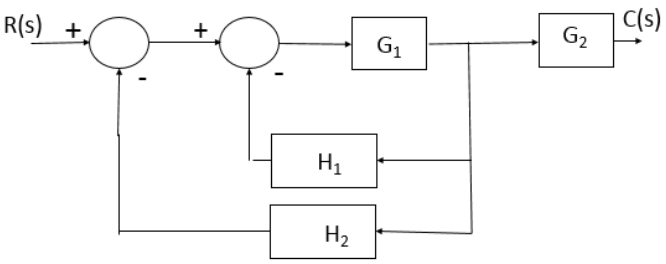


FIG.Q1C

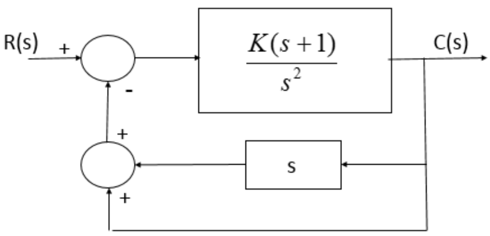
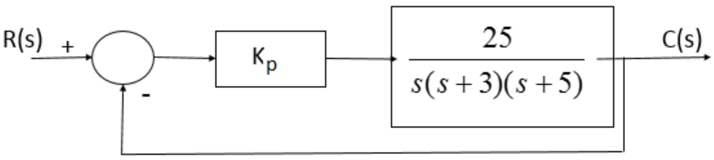
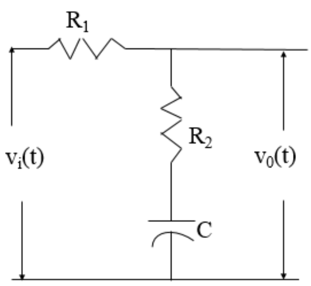


FIG Q2C



FIGQ3B



FIGQ3C